2000 Lake St. Clair Water Quality Assessment

EXECUTIVE SUMMARY

Background

Lake St. Clair and the Clinton River Watershed have demonstrated water quality problems, which have been documented throughout the 1980's and 1990's. In 1985, the International Joint Commission designated the lower Clinton River basin as an Area of Concern, due to elevated fecal coliform bacteria, total dissolved solids levels, contaminated sediments, and a degraded benthic macro invertebrate community. During the 1990's, the Macomb County Health Department frequently closed beaches on Lake St. Clair due to violations of total body contact standards for indicator bacteria.

Scope of the Study

The project included five complementary monitoring activities; near shore, off shore, watershed, bathing beach, and wet weather event. The near shore testing was conducted at 23 major outfalls to the lake, including river mouths and storm drain outfalls. Near shore sampling was conducted immediately adjacent to the outfalls. Off shore sampling was conducted at 11 sites, approximately one-quarter mile from shore. Seven of the off shore locations correspond to major near shore sample locations, two were adjacent to public beaches and two were municipal drinking water intake sites. Water chemistry and sediment bacteriological samples were collected during the spring, summer and fall seasons at near and off shore sites. Near shore water bacteriological samples and water quality meter readings (temperature, dissolved oxygen, conductivity, pH and turbidity) were collected weekly from April 27 through September 28, 2000. Off shore water bacteriology sampling and water quality meter readings were collected during the spring, summer, and fall seasons. Sediment chemistry samples were collected at all near shore, five off shore, and 20 watershed locations once during the program. Sediment and aqueous bacteriological samples were collected during the spring, summer and fall at 20 watershed locations. Lake sediment samples were collected at 100 locations distributed throughout the U.S. portion of the lake for mercury analysis.

Bathing beach water and sediment sampling was conducted at 15 sites on the public beaches along Lake St. Clair (Blossom Heath, Memorial Park, HCMA Metro park, and New Baltimore). Samples were collected monthly from May through September 2000 and analyzed for aqueous and sediment bacteriology.

Wet weather event sampling was conducted in the watershed during periods of rain (>0.5"). Water samples were collected for bacteriological analysis at 20 strategic locations between April and September 2000.

Results and Observations

Spatial and temporal variations were evident in the sample results, with several major trends apparent. In general, near shore levels for most parameters were higher than off shore levels, especially in bacteria and nutrient parameters. Sample locations at the Clinton River and Clinton River Spillway mouths generally exhibited significantly higher levels of measured parameters than all other sites. A strong relationship between near shore bacteria levels and rainfall was found.

There are several notable observations in this data set relating to sample locations and sites of concern. These include samples which exceed identified pollution criteria, and locations frequently exhibiting higher than average values for measured parameters. Numerical pollution criteria are identified in this study for nitrate, ammonia, biochemical oxygen demand, dissolved oxygen (DO), pH, turbidity and several of the sediment metals.

For parameters in which numerical pollution criteria were identified, several sites exceeded these criteria during one or more of the sample dates. A value of 0.3 mg/L was identified as a pollution threshold for nitrate. During the spring sampling event, all near shore sites and all but one off shore site met or exceeded this threshold value. The values of spring nitrate at the Salt River, Clinton River and Clinton River Spillway were greater than two times the threshold value. Many sites were below the reportable detection limit (RDL) for the summer and fall sampling events. However, several near shore sites continued to exceed the critical level.

A value of 0.2 mg/L was identified as a pollution threshold for ammonia. The Milk River and Liberty Drain exceeded the threshold during the spring sampling. No sites exceeded the threshold in the summer and fall samplings.

A value of 4 mg/L was identified as a pollution threshold for BOD. The Milk River and Liberty Drain exceeded the threshold during the spring sampling. During the summer sampling only the Liberty Drain exceeded the threshold. No sites exceeded the threshold in the fall sampling. Most samples collected throughout the sample period were below the RDL.

Dissolved oxygen, conductivity, pH and turbidity measurements were taken weekly at near shore sample sites and seasonally at off shore sites. Average DO, conductivity and pH results were within the recommended ranges, with the exception of DO and pH at the Irwin Branch Relief Drain (near shore site). A value of 5 mg/L was identified as a pollution threshold for DO. Individual DO levels below 5 mg/L were observed at Liberty Drain, Salt River and Irwin Branch Relief Drain. No off shore sites were below the pollution threshold for DO. The majority of the individual pH results were within the recommended guidelines (6.5-9), however, most near shore and off shore sample sites fell out of this range on at least one sampling date. The Irwin Branch Relief Drain (off shore site) was the only site with an a average pH that was not within the recommended range. Nearly all sample sites exceeded turbidity guidelines on at least one sample event. The disturbance of sediments by the boat propeller at shallow sample sites may contribute to the higher readings.

Results of metals analysis were compared to Ontario Ministry of Environment (OMOE) and United States Environmental Protection Agency (USEPA) sediment metal pollution classification guidelines. All of the metals exceeded a guideline at at least one sample location. Six of the 23 near shore sample sites exceeded at least one of these guidelines. The Liberty Drain, Stephens Relief Drain, and the Clinton River near shore sites exceeded the greatest number of guidelines. Three of the five off shore sample sites exceeded at least one of these guidelines. The Clinton River Spillway off shore site exceeded the greatest number of guidelines. Twelve of the 20 watershed sample sites exceeded at least one of these guidelines.

In the Clinton River there appears to be a trend of increasing concentration up stream to down stream for several sediment metals and nutrients. However, this observation is based on limited data for which statistical analysis is not possible.

Mercury was detected at 18 of the 100 lake sediment mercury sample sites. Fifteen of the sites with detectable levels of mercury were adjacent to the shipping channel, which may

link mercury contamination with the St. Clair River or dredging activities. Four sites exceeded the OMOE low effect level.PCB's were detected at four of the 48 monitored sites in the lake and watershed. All results were below 1 ppm.

Polynuclear aromatic hydrocarbons were detected at 14 of the 48 monitored sites in the lake and watershed.

Pesticides were not detected at any of the 48 sites monitored in the lake and watershed. The data was evaluated to assess the impact of climatological variables, sanitary sewer overflows, retention basin discharges, and combined sewer overflows on surface water quality. An estimate of the effect of rainfall and total sewer overflows on average bacterial levels in the near shore samples was obtained. A strong correlation (R2=0.88) was found between average near shore E. coli levels and precipitation 72 hours prior to sampling. A strong correlation (R2 =0.80) was also found between average near shore E. coli and total sewer overflows 72 hours prior to sampling. No association was found between average near shore E. coli levels and wind direction or wind speed.

Off shore E. coli levels throughout the study were very low. The highest off shore E. coli level was ten, which is far below the total body contact standard of 300 cfu/100 ml.

The design of the wet weather event sampling portion of the study emphasized sampling during heavy rainfall or after known SSO, CSO or retention basin discharges. As such, it was sometimes difficult to predict when a plume of sewage passed through sample points and to capture a water sample at the right time and location. The rainfall measurements used to predict bacteria levels throughout the county were taken from Selfridge Air National Guard Base, and do not represent the true spatial distribution of rainfall throughout the county. These limitations may explain why there was no correlation observed between rainfall and E. coli concentration in the watershed event sampling. Sediment E. coli samples were collected at near shore, off shore, watershed and beach sample locations. No correlation was found between aqueous and sediment E. coli.

Numerous sample locations that exceeded pollution thresholds or had consistently higher than average results for the parameters measured in 1998 and 1999 had similar results in 2000. Many temporal and spatial trends in the data that were identified in the 1998 and 1999 Lake St. Clair Assessment were again evident in the 2000 Lake St. Clair Assessment.

The correlation between average near shore E. coli levels and rainfall 72 hours prior to sampling was also observed in 1998 and 1999. In 1998 the R2 value was 0.83 and in 1999 the R2 value was 0.57.

In time the data sets from the annual assessments will be combined and evaluated as a whole. Continued sampling of the lake will provide an opportunity to understand both the natural and anthropogenic influences on water quality. Additionally, long term trends in water quality will become apparent.

Summary

The primary objective of this project was to augment the existing surface water quality database for future reference and comparison. This data set extends the benchmark of water quality, which began in 1998. It represents the western portion of Lake St. Clair bordering Macomb County, including near shore, off shore, watershed and beach sample locations during the spring, summer, and fall seasons. It encompasses a wide range of parameters, including inorganic, organic and microbiological measures, for both water and

sediment. Spatial and temporal trends are apparent for many parameters measured.

This data set represents the beginning of a working database containing water quality information for Lake St. Clair, with multiple potential utility. The database will be useful as a tool to address specific questions related to water quality in Lake St. Clair including the potential identification of streams and drains contributing specific types of pollution to the lake, pollutant dynamics, and the relationships of pollutant levels to environmental factors. Such factors may include known point and non-point source pollution inputs, land use and other landscape factors, and climatological conditions. These types of analyses may elucidate relationships and information useful to the goal of water quality improvement in the lake and surrounding watershed. This database can provide information useful to scientists, environmental protection workers, planners, natural resource and recreation managers, as well as municipalities and townships.

Future Projects and Applications

An immediate goal should be to make this database accessible to persons that may find it useful, including scientists, environmental protection workers, planners, natural resource and recreation managers, as well as municipalities and townships. Additionally, analysis of the entire available set of existing surface water bacteria data in conjunction with spatially distributed sources of rainfall data would likely yield more conclusive information pertaining to the correlation of surface water bacteria with sanitary sewer overflows, retention basin discharges and combined sewer overflows. A predictive model of surface water bacteria based on rainfall and other environmental data would be a useful product of this effort.

Future monitoring data will build upon the existing database, permitting evaluation of trends in water quality over time as well as space. It should reflect the previous year's results and fill data gaps, permitting more conclusive evaluation of the data. This will be useful in better understanding of pollutant dynamics in the lake and in the appraisal of efforts to improve water quality.

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